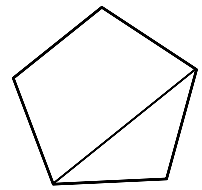
1. How many diagonals does a regular pentagon have? A diagonal is a line segment that joins two non-adjacent vertices. 1. ____________ diagonals



2. Let $N = 6$. Evaluate $N^2 + 6N + 9$. 2. ____________

3. How many different sums are possible when we roll 2 standard dice? 3. ____________ sums

4. Your sock drawer has 20 socks in it: 10 white, 10 black, but otherwise identical. If you are looking for socks in the dark, how many socks must you take out before you can be assured of a pair of the same colour? 4. ____________ socks

5. 20% of 17 is how many percent of 85? 5. ____________ percent

6. What is the circumference of a circle whose area is $\dfrac{16}{\pi}$ square units? 6. ____________ units

7. What is the remainder when you divide the smallest prime larger than 50 by the largest prime smaller than 20? 7. ____________

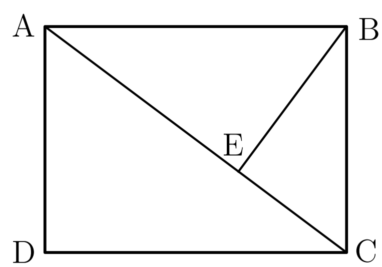
8. What is the value of $\dfrac{\sqrt{b^2-4ac}-b}{2a}$ when $a=1$, $b=3$, and $c=-4$? 8. ____________

9. Find 40% of 25% of 15255. Express the answer to one place after the decimal point. 9. ____________

10. Express $\dfrac{7}{11}+\dfrac{11}{7}$ as a fraction in lowest terms. 10. ____________

11. If 3 chocolate bars cost \$8.19, and 4 energy bars cost \$9.72. what is the total cost of 2 chocolate bars and 2 energy bars? Express your answer in dollars correct to 2 decimal places. 11. ____________ dollars

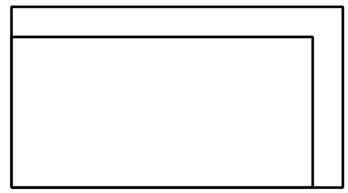
12. The rectangle $ABCD$ has $AB=8$ cm, and $BC=6$ cm. Determine the length of BE, where BE is an altitude of $\triangle ABC$. Express the answer in cm, to one decimal place. 12. ____________ cm



13. Last week, Alan read every second page of his 200 page textbook, starting with page 1. This week, Alan read every third page of the textbook, again starting with page 1. How many pages did Alan read twice? 13. ____________ pages

14. There are 31 students in the class. Of them, 20 got an A in Math, 15 got an A in Language Arts, and 11 got an A in both Math and Language Arts. If we choose a student at random from this class, what is the probability the student got an A in Math but not in Language Arts? Express the answer as a common fraction. 14. ____________

15. The inner rectangle has perimeter 2014 units. If each side of the rectangle is increased by 5 units, as indicated in the not to scale picture, by how many units does the area of the rectangle *increase*? 15. ____________ units^2



16. A snail is on the wall of a well, 10 metres down. Each hour, she is able to climb straight up 1 metre, but then, since she is very tired, she slides back down $\frac{2}{3}$ metres before starting upward again. How many hours will it take her to reach the top of the well? Once she reaches the top she does not slide. 16. ____________ hours

17. An arithmetic sequence $a_1, a_2, a_3, a_4, \ldots$ is a sequence of numbers such that the difference between any two consecutive terms is constant. If $a_{10} = 43$ and $a_{12} = 51$, what is the value of the first term a_1 of the sequence? 17. ____________

18. What common fraction is exactly halfway between $\frac{10}{11}$ and $\frac{11}{12}$? 18. ____________

19. Alphonse and Beti each have a certain number of loonies. Suppose that three-quarters of the number of loonies that Alphonse has is equal to four-fifths of the number of loonies that Beti has. What is the smallest possible positive total number of loonies they could have between them? 19. ____________ loonies

20. What is the ratio of the surface area of a rectangular $4 \times 6 \times 9$ box to the surface area of a cube with the same volume? Express the ratio as a common fraction. Note that the answer is greater than 1. 20. ____________

21. Determine $x + y - z$ if the following equations all hold: 21. ____________

$$\begin{aligned} 2x - 2y + z &= 5 \\ 3x + 4y - z &= 11 \\ 3x - y + z &= 10 \end{aligned}$$

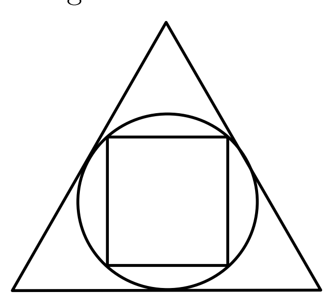
22. A line passes through $A(1, -1)$ and $B(5, 4)$. If the line has equation $y = mx + b$, what is the value of m? Express the answer as a common fraction. 22. ____________

23. What is the sum of the units digits of all the multiples of 4 between 1 and 2014? 23. ____________

24. If $9^x + 9^x + 9^x = 9^{2014}$, what is the value of x? Express the answer as a common fraction. 24. ____________

25. How many different 4-letter "words" can be formed using 4 of the 7 letters in the word OSOYOOS? 25. ____________ "words"

26. A square with side 1 is inscribed in a circle, which is inscribed in an equilateral triangle. Find the area of the triangle. Express the answer in the form $\frac{a\sqrt{d}}{b}$, where a, b, and d are integers, a and b are relatively prime, and d has no square divisor greater than 1. 26. ____________ units^2



Bull's-eye, Page 1: Problem Solving

1. John has 3 dimes (10 cent coins) and 11 nickels (5 cent coins). Brenda has 4 more dimes than John, and has 13 nickels. How much more money, in cents, does Brenda have than John?

1. ____________ cents

2. Jill's goal is to do the Grouse Grind on 5 consecutive days, taking an average of 1 hour and 10 minutes per day. On Monday, it takes Jill 1 hour and 28 minutes to do the Grind. On Tuesday, it takes her 1 hour and 14 minutes. On Wednesday, it takes her 1 hour and 10 minutes. On Thursday it takes her 1 hour. What must be her time on Friday, in minutes, so that she can attain her goal?

2. ____________ minutes

3. Two cyclists are 20 km apart when they start riding toward one another, each going at 15 km/h. At the same moment, a bumblebee leaves the handlebars of one cyclist and flies toward the other. When the bee reaches the second cyclist, she instantly turns around and flies back toward the first. If the bee flies back and forth at 25 km/h, how many km will she have travelled before the cyclists meet each other? Express the answer as a common fraction.

3. ____________ km

4. When they sit to eat together, Hyena and Wolf can eat an antelope in 5 hours. Eating together, Wolf and Lion can eat an antelope in 4 hours, while Lion and Hyena can eat an antelope in 3 hours. How many hours would it take for Hyena, Wolf, and Lion to eat an antelope? Express the answer as a common fraction.

4. ____________ hours

Bull's-eye, Page 2: Numbers and Combinatorics

5. Suppose that N is positive and $\dfrac{N(N-1)}{2} = 990$. What is the value of N?

5. ____________

6. Define the sequence a_1, a_2, a_3, a_4, and so on as follows. Let $a_1 = 13$. If a_n is odd, let $a_{n+1} = 3a_n + 1$. If a_n is even, let $a_{n+1} = a_n/2$. What is the smallest positive integer k such that $a_k = 1$?

6. ____________

7. You start with a score of 0 and then roll a die three times. Each time you roll a number greater than 3, you add the number you rolled to your previous score. Otherwise, you subtract 2 from your previous score. What is the probability that your score after three rolls is 1? Express the answer as a common fraction.

7. ____________

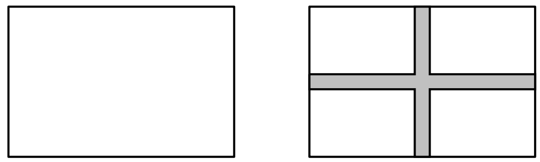
8. How many different averages of 2 primes (not necessarily different) are there if both primes have to be less than 20?

8. ____________

Bull's-eye, Page 3: Geometry

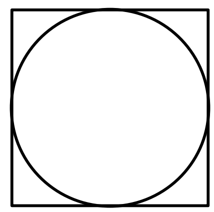
9. Alicia had a rectangular 20 feet by 30 feet garden (left-hand picture). She decided to make a 2 foot wide path in the garden as in the right-hand picture. How many percent of the area of the original garden is lost to the path?

9. ____________ percent



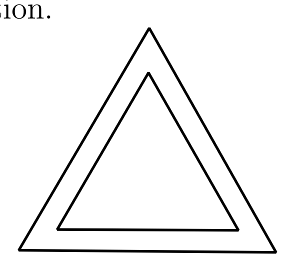
10. .A circle is inscribed in a square that has *perimeter* $\frac{3}{\pi}$. What is the circumference of the circle? Express the answer as a common fraction.

10. ____________ units



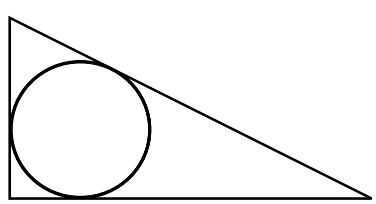
11. Both triangles in the picture are equilateral and have the same centre. The sides of the inner triangle are parallel to the sides of the outer triangle. The distance between corresponding edges of the two triangles is equal to one-tenth of the height of the outer triangle. What is the ratio of the area of the inner triangle to the area of the outer triangle? Express the answer as a common fraction.

11. ____________



12. A circle is inscribed in a right triangle with legs $\sqrt{2}$ and $2\sqrt{2}$. What is the area of the circle? Write the answer in the form $(A - \sqrt{B})\pi$, where A and B are integers.

12. ____________ units^2

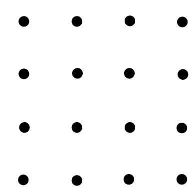


Co-op, Page 1: Team answers must be on the *coloured* page.
Answers on a white page will not be graded.

1. Let $f(n) = \dfrac{1}{(n-2)!} + \dfrac{1}{(n-1)!}$. Express $f(7)$ as a common fraction. 1. ____________

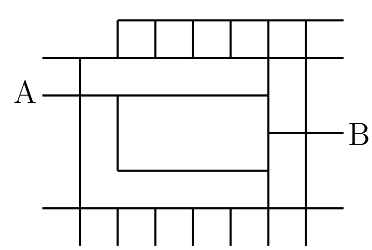
2. What is the units digit of the sum $1^4 + 2^4 + 3^4 + \cdots + 59^4 + 60^4$? 2. ____________

3. Every point in the 4×4 grid below is at distance 1 from its nearest horizontal or vertical neighbours. Two different points of the grid are chosen at random. What is the probability that the distance between these two points is equal to $\sqrt{5}$? Express the answer as a common fraction. 3. ____________



4. Three fair dice are rolled. You win if one of the following happens: (i) the sum of the dice is 10 or (ii) all the dice show the same number or (iii) the dice show the three numbers 3, 4, and 5. Express the probability that you win as a common fraction. 4. ____________

5. You start walking at point A and end your walk at point B and you walk along the lines. Whenever you reach an intersection you are only allowed to keep going straight or to turn right. Each small segment has length 100 metres. What is the smallest possible length of your walk? 5. ____________ metres



Co-op, Page 2: Team answers must be on the *coloured* page.
Answers on a white page will not be graded.

6. Jacob starts to walk at 6 km/hr and increases his speed at a constant rate until he reaches a speed of 10 km/hr after 4 minutes. He, then, maintains his speed at 10 km/hr for some time. Then, he cools down by reducing his speed at a constant rate until coming to a complete stop (after 5 minutes of cooling down). If total walking time was 1 hour, what distance did he walk (in km correct to 2 decimal places)?

6. ____________ km

7. Jacob (see Question #6) calculates the number of calories he burnt as follows. He burns 1 calorie per every 10 heart beats. Walking up to a speed of 6 km/hr, his pulse rate (heart beat) is 60 per minute. Walking at speed greater than 6 km/hr his pulse rate changes at constant rate with respect to his speed and reaches 140 per minute at speed of 10 km/hr. When he cools down his pulse rate slows down in the same fashion. How many calories did Jacob burn during his 1 hour walk?

7. ____________ calories

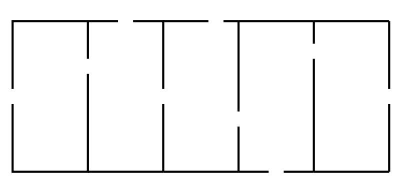
8. An ice cream cone with height 10 cm and radius 2.5 cm is full with ice cream. On top of the cone, foamy cream is sprayed and forms a shape of hemisphere with radius 2.5 cm. The density of the ice cream is 0.9 g/cm^3 and the density of the foamy cream is 0.05 g/cm^3. What fraction of the total weight (of ice cream and foam) is the weight of the ice cream? Give the answer correct to 3 decimal places.

8. ____________

9. The decimal expansion of 25! ends with six zeros. What is the last (rightmost) non-zero digit in the decimal expansion of 25!?

9. ____________

10. A builder divides a rectangular building so it has 5 rectangular rooms. Any two rooms with a common wall have exactly 1 door connecting them, and each room that has an outside wall has exactly 1 exterior door. What is the maximum possible number of doors? Below is a sketch of a valid room layout that doesn't necessarily produce the maximum number of doors.



10. ____________ doors

Co-op, Page 3: Team answers must be on the *coloured* page.
Answers on a white page will not be graded.

11. What is the ratio of the volume of a sphere to the volume of a cube when the cube is the largest possible that can fit entirely within the sphere? Give your answer as a decimal correct to 2 decimal places. 11. ____________

12. Start with the following 12-letter word: AABBCCDDABCD. How many different words can you create by swapping exactly 2 letters? Note that the original word is one of these words. 12. ____________ words

13. The world population is N where N is between 7 and 8 billion. If you write N in its binary representation, how many digits will you write? 13. ____________ digits

14. If the nominal interest rate is r, compounded k times per year, then D dollars grow to $D\left(1+\frac{r}{k}\right)^k$ dollars in a year. Here if the interest rate is what would usually be called 10%, then $r = 0.10$. 14. ____________

    Suppose you have D dollars to invest. Assume the nominal yearly rate is 12%. Find the ratio of the amount returned after two years if interest is compounded monthly to the amount returned after two years if interest is compounded half-yearly. Express the answer as a decimal, correct to 3 places after the decimal point.

15. A *Pythagorean triangle* is a right-angled triangle all of whose sides are integers. How many Pythagorean triangles have hypotenuse which is 30 or less? (Note that for example the triangle whose sides are 3, 4, and 5 is the "same" as the triangle whose sides are 4, 3, and 5, which is the same as the triangle whose sides are 5, 4, and 3.) 15. ____________